APS Storage Ring Beam Position Monitors Upgrade Status

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- Monopulse BPM upgrade status
- X-ray BPM interface upgrade status

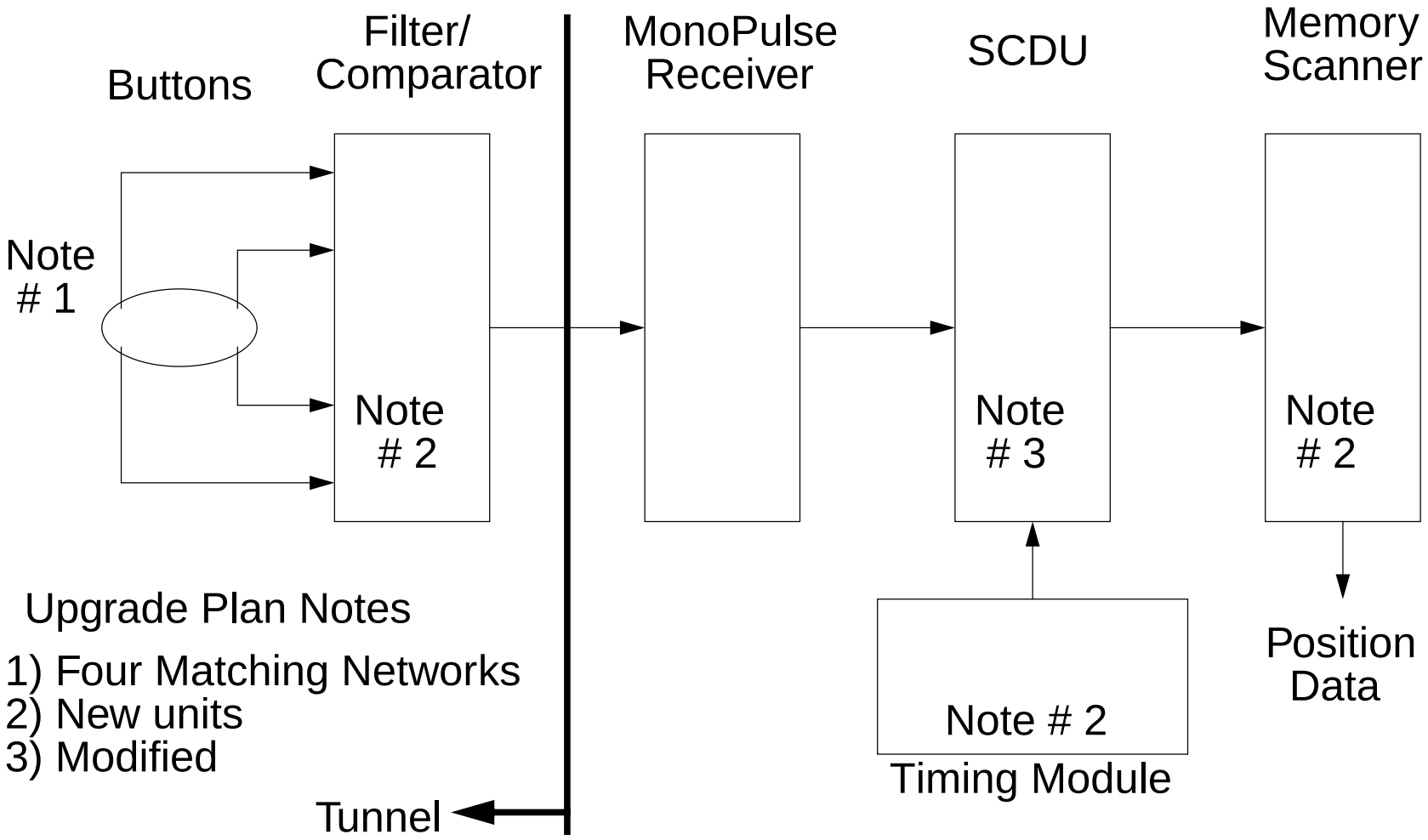
APS Storage Ring Monopulse BPM Upgrade Status and Plans

- Motivation
  - Present RF front-end configuration limitations:
    - Requires deadtime of > 400ns, constraint on bunch pattern.
    - Requires a large amount of charge, needing target cluster of six (10 to 15 mA).
  - Trigger issues:
    - Beam based fast trigger has termination mismatch and large trigger walk.
    - Present timing system trigger has jitter and lacks fine settability.
    - Presently used log video sum trigger is susceptible to intensity dependent trigger walk.
  - Top-up Stability:
    - During Top-up operation, a cogging trigger technique is desirable, but above limitations inhibit use of it.

APS Storage Ring Monopulse BPM Upgrade Status and Plans

- Motivation (cont'd)
  - Boxcar averager limitations (Memory Scanner):
    - Boxcar averager produces side lobes, resulting in under-sampling and thus aliasing errors.
  - IOC CPU overloads when sampling and computing at 60 Hz to get 30 Hz band rms motion data.
  - Present beam dump post-mortem analysis is relatively unreliable.

Monopulse BPM Configuration



Upgrade Status

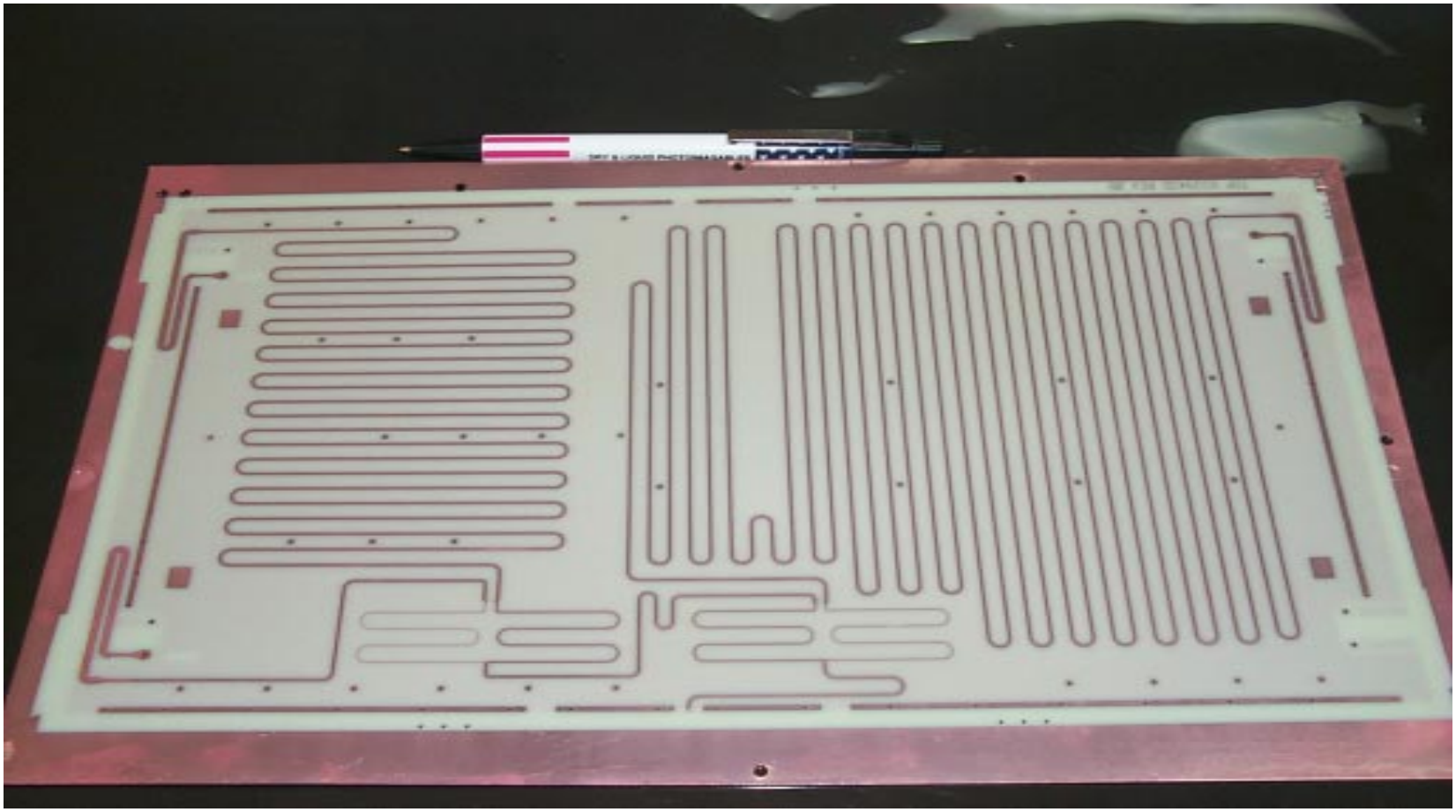
- RF front-end upgrade status:
  - Matching network installation (a total of approx. 1440 units) completed; provides 4 dB signal enhancment.
  - Sector 25 SCDU modifications for timing and self test are complete.
  - Prototype filter / comparator commissioned at S25A:P1, meets all performance requirements e.g. 1 mA single bunch operation.
  - Filter / comparator fabrication difficulties have arisen in bonding process.
  - Core delaminates at the interface; shows voids in the bonding.
  - Progress has been made by switching to other materials, but it adds to the cost.
  - Progress has also been made using non-bonding technique; a pre-prototype filter module (1/3rd) in house and being tested; looks promising.

Upgrade Status

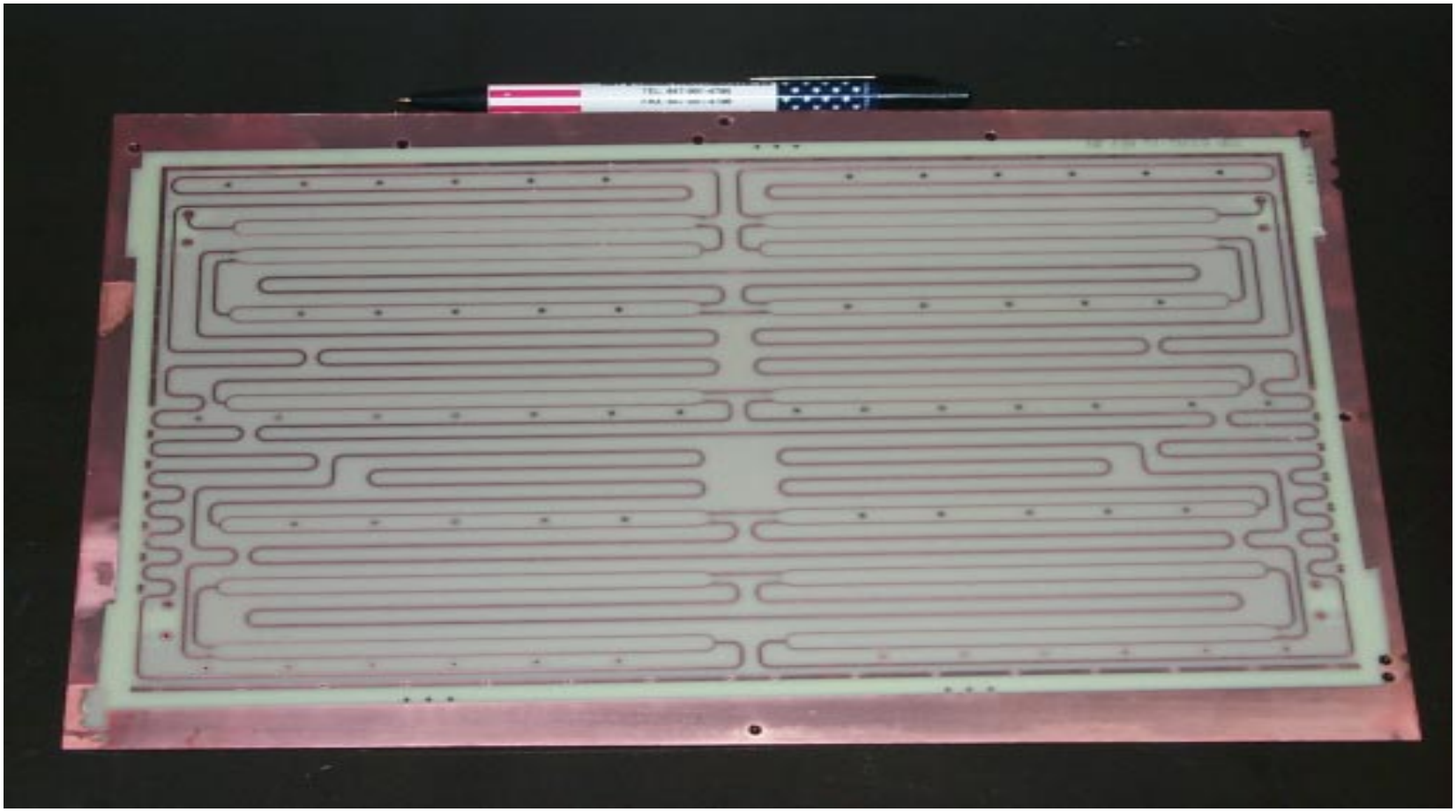
- Timing system upgrade status:
  - Bunch clock generator and new VXI timing module commissioned for sector 25.
  - Minor modification in progress to incorporate beam history dump trigger.
  - Production of 20 bunch clock generators and 40 VXI timing modules has started; expected delivery in December/January.
- BPM digital processor status:
  - Prototype bpm digital processor (replacement for existing memory scanner) board complete, software development and testing underway.
  - Prototype expected to be commissioned during January, 2001 study period - production to follow (4 to 6 months).
  - Beam history module upgrade comes free with this new design.

Matching Networks

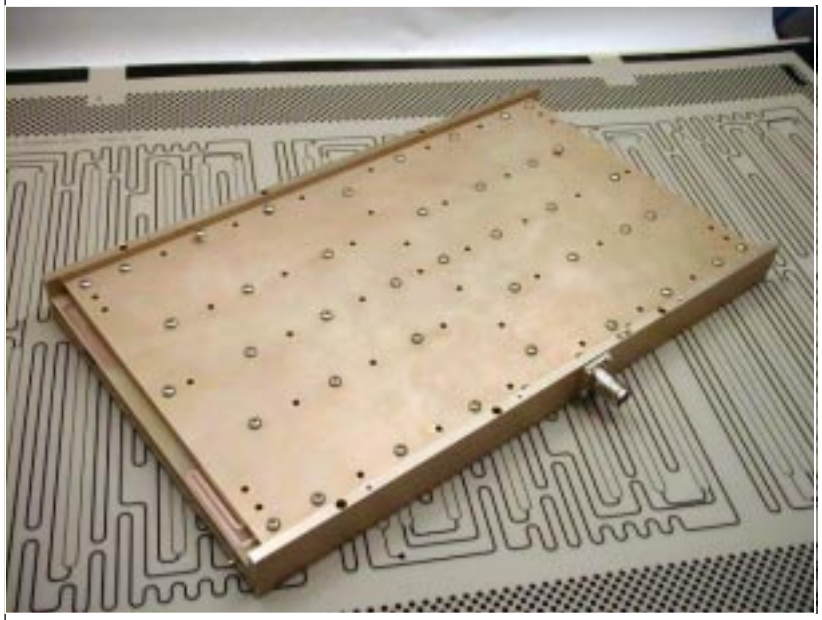
Non-bonded Unequal 3-way Board



Non-bonded Unequal 8-way Board



24-pulse Transversal Filter Assembly

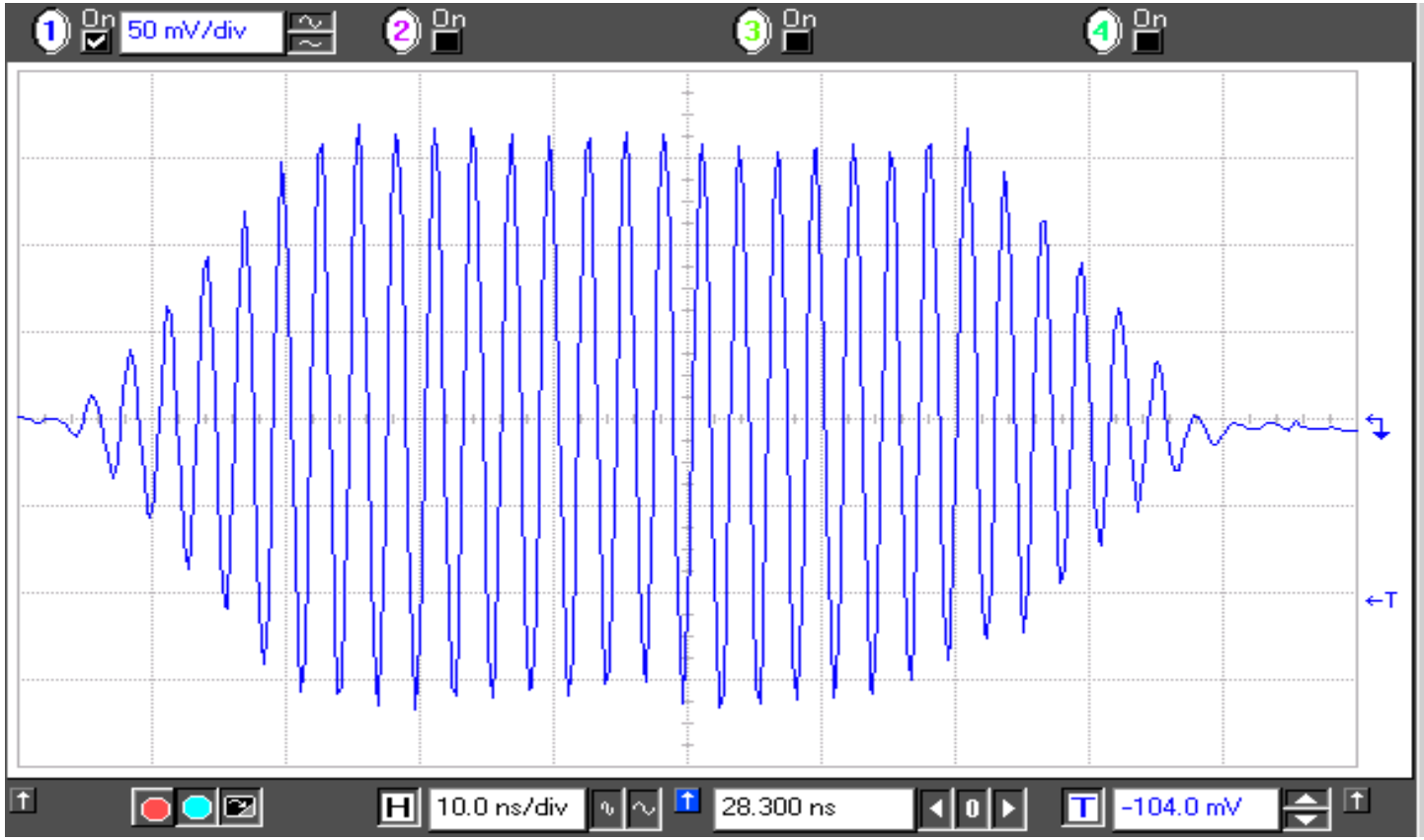


1st Generation Micro Strip Filter design

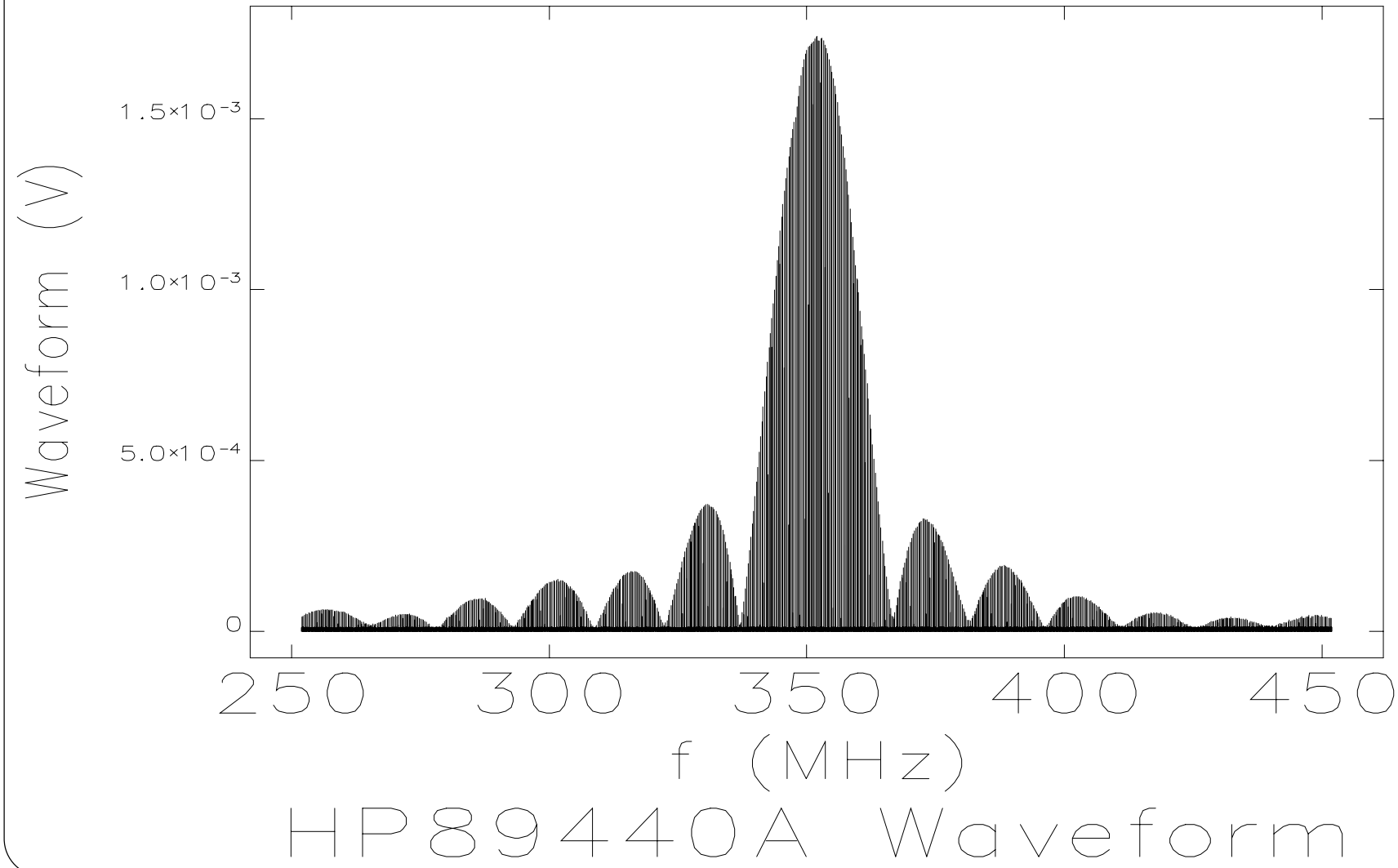
First Article S25A:P1 Bonded Unit

1st Article unit Results - Upgrade Status

Transversal filter time domain response from target cluster of six



Sum Channel Single-Bunch Spectrum



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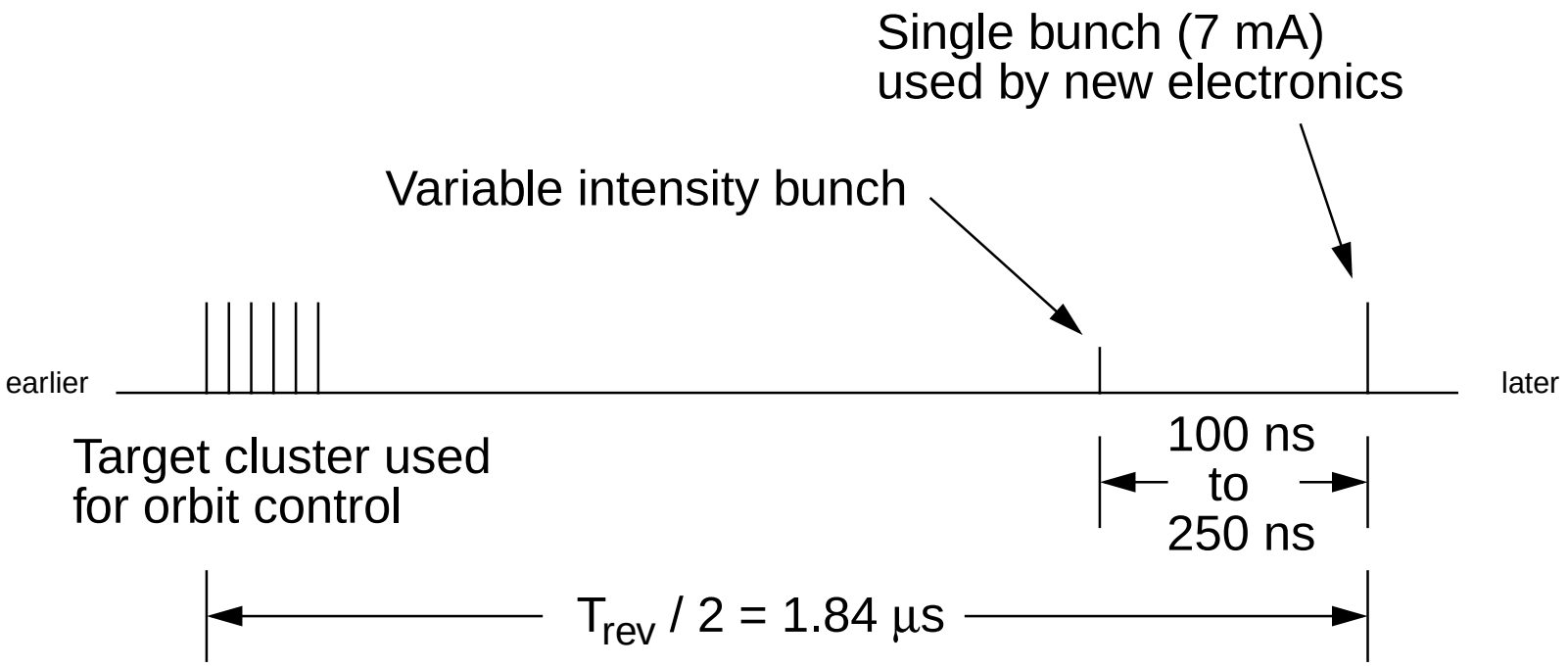
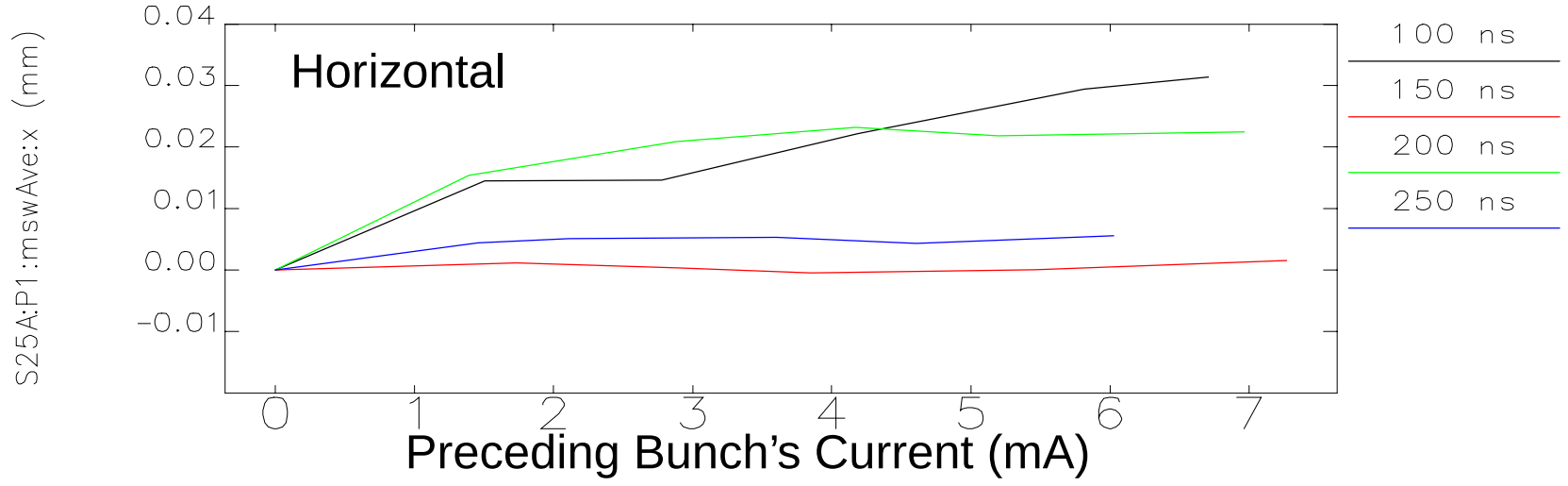
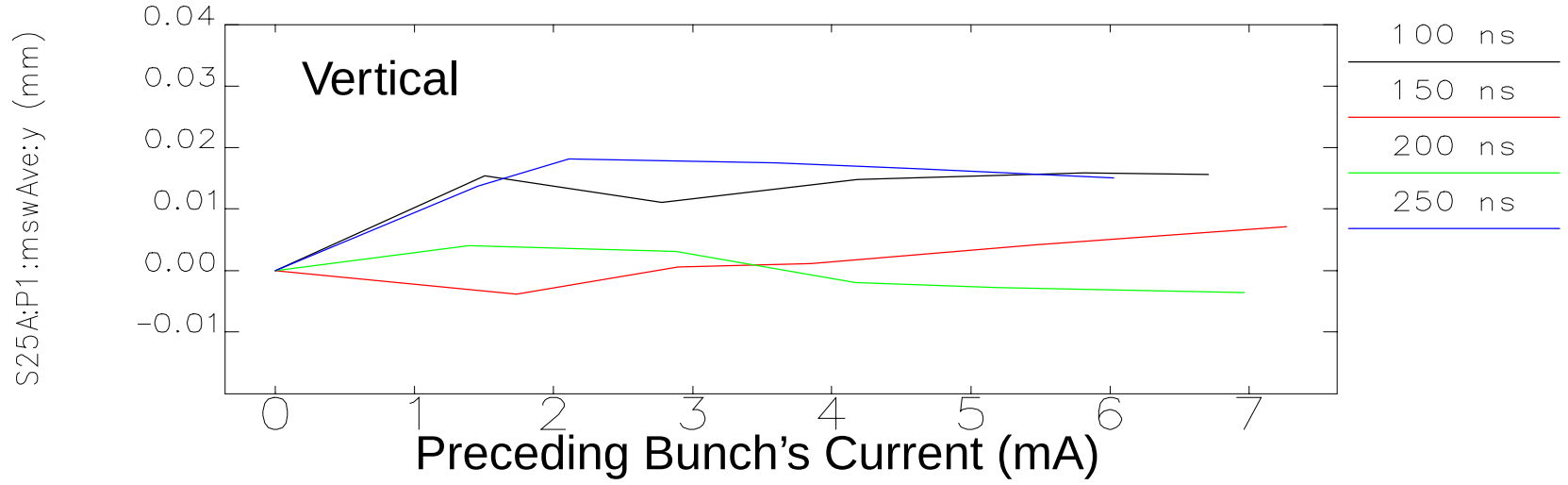
Bunch pattern used for measurement of bunch interaction effects.



Variation of position readback from bunch interaction vs bunch separation





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APS Storage Ring XBPM Interface Upgrade Status and Plans

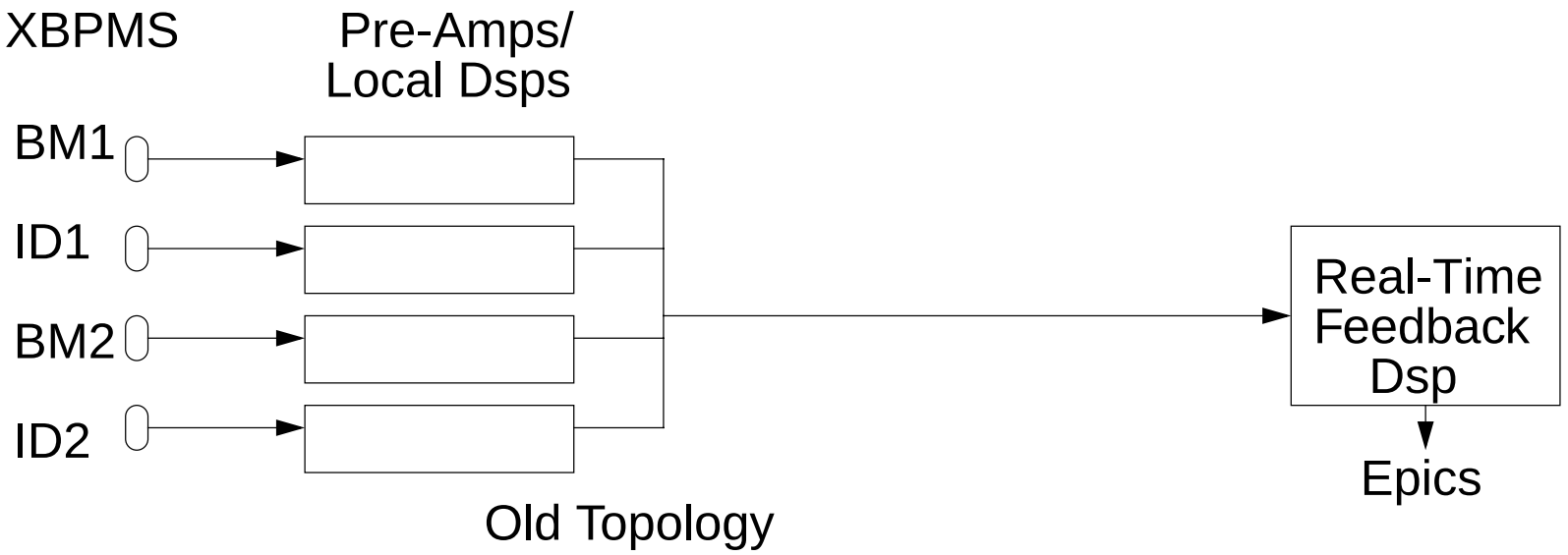
Om Singh

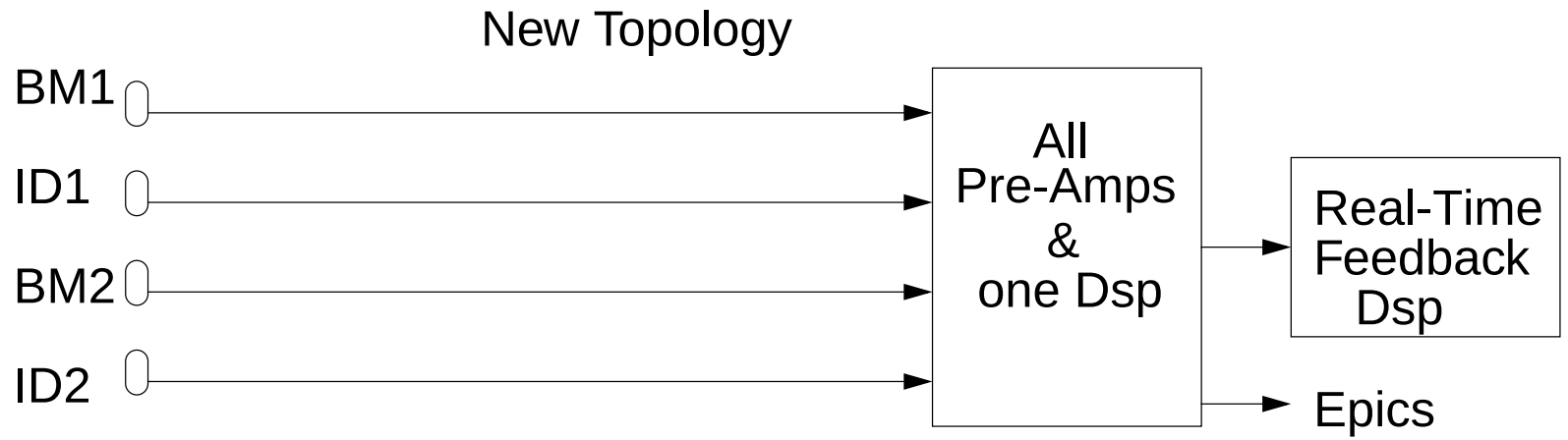
- Motivation - why use XBPMs for orbit control ?
    - Superior design of XBPM's assembly and support structure provides:
        - Vibration displacement < 0.1 microns
        - Very small dependence on environmental temperature changes
    - Lever arm for X-ray bpm's derive from 16 to 20 meter source-detector distance, while rf bpm separation at ID's is only 5 meters.

APS Storage Ring XBPM Interface Upgrade Status and Plans

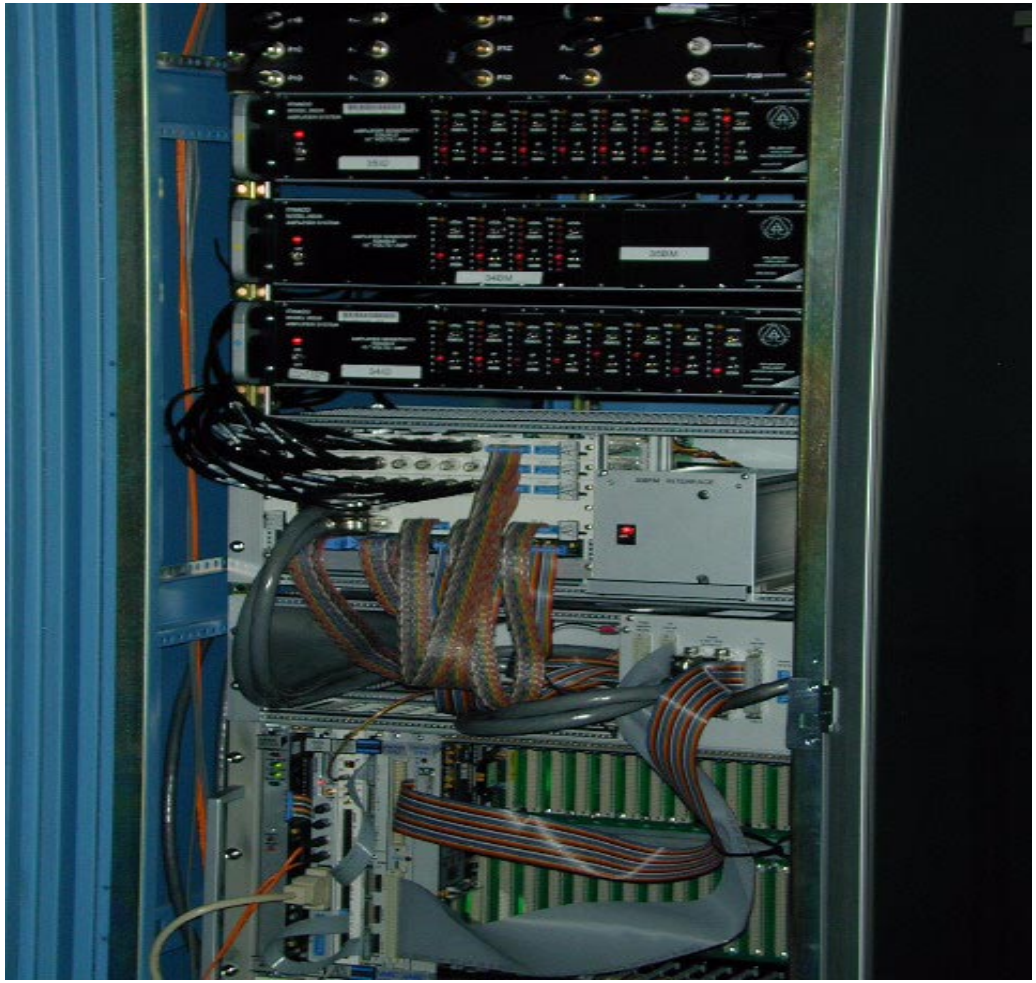
Om Singh

- Motivation (cont'd)
  - Existing XBPM interface is not suitable for orbit controls.
  - Aliasing errors are caused due to improper filtering.
  - No epics controls for pre-amplifiers.
  - Local DSP software is under utilized and is not easily upgradeable - makes it hard for future development.
  - Improper topology - A real-time feedback DSP is utilized to collect and process blade data - causing overloading.


XBPMS
Pre-Amps/
Local Dsps
BM1
ID1
BM2
ID2
Real-Time
Feedback
Dsp
Epics
Old Topology


New Topology
BM1
ID1
BM2
ID2
All
Pre-Amps
&
one Dsp
Real-Time
Feedback
Dsp
Epics

New X-bpm Interface - Sector 34/35



Upgrade Status

- Upgrades affecting x-bpms's in sectors 32, 33, and 34 are complete, including 1) new controls and data acquision with dsp-based digital filtering, and 2) completion of "Decker-distortion" to reduce ID x-bpm stray radiation background.
- Orbit control using x-bpms located in three BM front ends and three ID front ends simultaneously during user operation has been performed (14BM, 33BM, 34BM, 32ID, 33ID, 34ID).
- Controls on ID lines has been at fixed gap to date, although significant effort has been invested in understanding x-bpms systematics associated with gap changes.
- With x-bpm orbit control, a vertical pointing stability of 0.2 microradian rms and a horizontal pointing stability of better than 1.0 microradians rms for 48 hours has been achieved. Typical numbers without x-bpms are in the 1 to 2 microradian rms range.

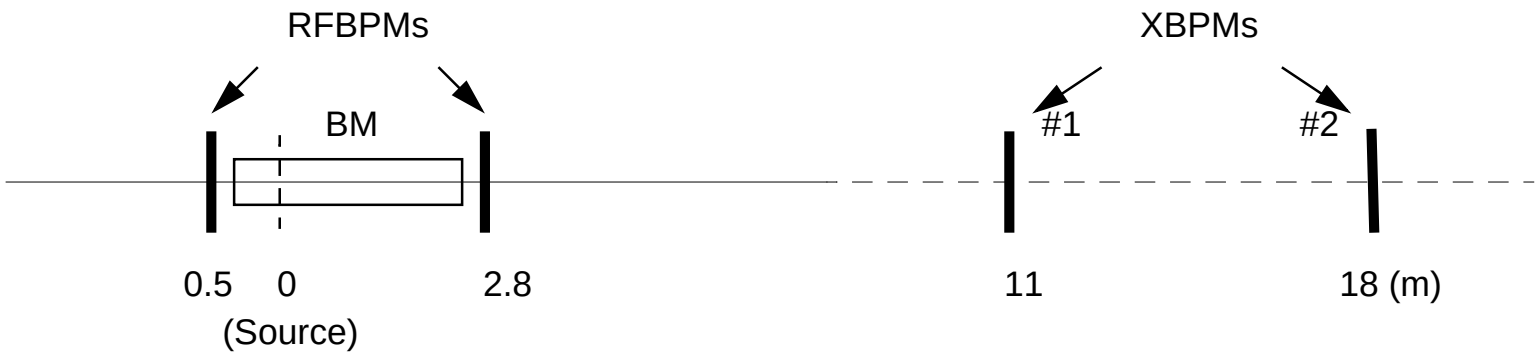
Upgrade Status - continued

- Lattice distortions are in progress in sectors 2, 3, and 4 (supporting 2-ID and 3-ID).
- Orbit control studies continue which should allow variable gaps with excellent long term stability.
- An epics-based xbpm translation stage's control has been commissioned which will expedite blade alignment during study. This unit is also planned to be used to calibrate rfbpms, to get another calibration point.
- The shakedown of xbpm translation stage's interface is in progress to ensure the maintainability and reliability (limit switches and the motors). Several of these have been found damaged and now replaced.

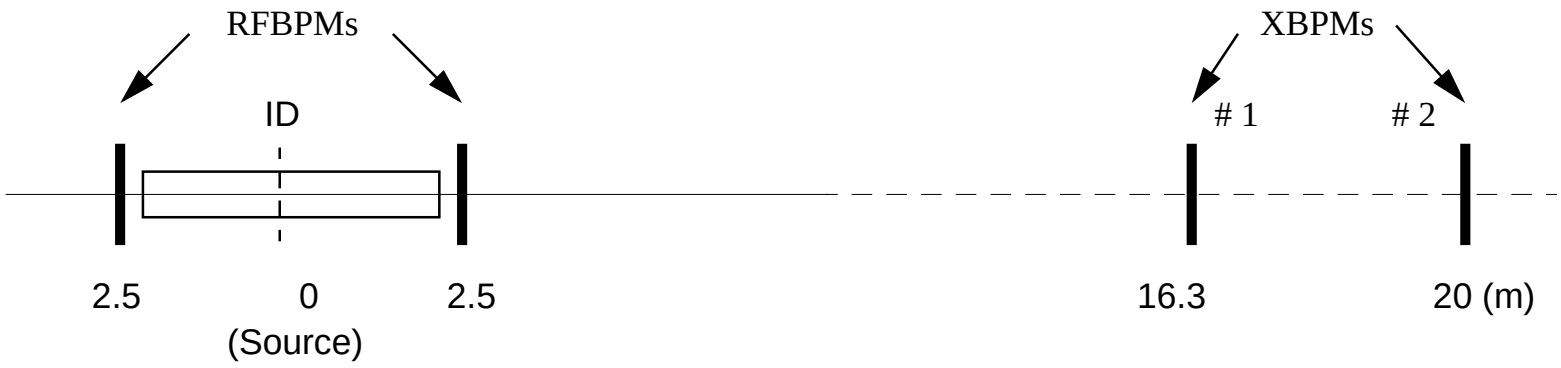
Upgrade Status - continued

- Production units will be available starting late November, 2000.
- Four units will be commissioned during December 2000 shutdown, allowing upgrades for X-bpms in sector 1 through 8. Other remaining units will be commissioned during April, 2001 shutdown.
- The commissioning of BM beamline X-bpm based orbit control for sectors 1 through 8 is to start January, 2001.
- The commissioning of ID beamline X-bpm based orbit control for sector 2 through 5 is also to start January, 2001 - assuming “decker distortion” are done to sector 5 and 6 during December, 2000 shutdown.

Bending Magnet and BPM Layout



Insertion Device and BPM Layout



APS Insertion Device X-ray BPM Blade Geometry